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Development Phase

**NOAAPORT Broadcast System Document**

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# NOAAPORT Broadcast System Document

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# NOAAPORT Broadcast System Document

## 1.0 Introduction

### 1.1 System Identification

The NOAAPORT Broadcast System (NBS) provides one-way communication of National Oceanic and Atmospheric Administration (NOAA) environmental data and information in near-real-time to NOAA users and to external users throughout the United States. This data broadcast is implemented by the Advanced Weather Interactive Processing System (AWIPS) Satellite Broadcast Network (SBN) subsystem. AWIPS is part of the National Weather Service (NWS) modernization program and has interfaces to a number of weather data collection and observation systems and to organizations that prepare weather-related data products. Many of these data are broadcast over the NBS.

AWIPS is identified as follows:

System Identifier:	AWP
Title:	Advanced Weather Interactive Processing System
Abbreviation:	AWIPS
Customer:	Department of Commerce, National Oceanic and Atmospheric Administration
System End User:	National Weather Service
System Developer:	PRC Inc.

This release of the NOAAPORT Broadcast System document reflects the NBS and SBN as of 1 September 1997, at which time there were four data channels being broadcast.

### 1.2 Purpose

The purpose of this document is to provide a clear and complete description of the NBS with emphasis on the information needed to receive and access the broadcast data. It describes in general terms the data sources, data collection, and transmission system. It also provides detailed information on the characteristics of the broadcast signal and protocols used, which will permit procurement or implementation of receiver systems independent of the AWIPS contract.

**The information contained in this document is correct at the date of publication but is subject to change. Individuals or organizations using this information are responsible for verifying that they are using the current release. Neither PRC nor NOAA/NWS is obligated to support users of this information outside the scope of the AWIPS contract.**

This document is related to the NOAAPORT Receive System document, which provides a description of the hardware and software design of a prototype NOAAPORT Receive System.

This NBS document does not provide detailed descriptions of the content and format of data products that are broadcast over the NBS but references appropriate NOAA/NWS documents that contain this information.

### 1.3 Overview

The NBS is implemented by the AWIPS SBN, which performs the point-to-multipoint communications function required by AWIPS. AWIPS provides data processing equipment, applications processing software, database management, systems support software, and communications to forecasters and researchers at NWS and NOAA offices throughout the United States, including the Weather Forecast Office (WFO), River Forecast Center (RFC), National Center (NC), and National and Regional headquarters (HQ) sites. Data from these offices are forwarded to the central Network Control Facility (NCF), which is located at the NOAA offices in Silver Spring, Maryland. The NCF also receives data input from the NWS Telecommunications Gateway (NWSTG), also located in Silver Spring, and receives satellite imagery files from the National Environmental Satellite Data and Information Service (NESDIS) facility in Camp Springs, Maryland. Exhibit 1.3-1 shows an overview of the downlink side of the NBS (2 channels). Exhibit 1.3-2 shows a 4-channel receive system.

At the NCF, data from various sources are received, stored, and formatted into data streams for broadcast. The initial three data streams are currently as follows:

- The GOES EAST data stream consists of imagery data from the GOES EAST satellite and includes visible (VIS), infrared (IR), and water vapor (WV) infrared images for the Eastern Conterminous United States (CONUS), Puerto Rico, supernational composites, and Northern Hemisphere (NH) composites.
- The GOES WEST data stream consists of imagery data from the GOES WEST satellite and includes VIS, IR, and WV infrared images for CONUS, Alaska and Hawaii; supernational composites, and NH composites.
- The National Centers for Environmental Prediction (NCEP)/NWSTG data stream provides the NCEP model output; the observations, forecasts, watches and warnings generated by the NWS forecast offices; as well as most observational data over North America from the NWSTG.

The formatted data streams are encapsulated in the SBN protocol (described in detail in Appendix A of this document) and sent from the NCF to the uplink transmitter site, known as the Master Ground Station (MGS), at Ft. Meade, Maryland. At the MGS, each data stream is modulated and converted to a C-band signal for transmission to the Spacenet IV communication satellite in a geostationary orbit at 101° W longitude. All of CONUS, as well as Alaska, Hawaii, and Puerto Rico, are able to receive the downlink broadcast from this satellite.

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**Exhibit 1.3-1. NOAAPORT Receive System Relationship to SBN and User's System (2-Channel)**

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**Exhibit 1.3-2. NOAAPORT Receive System Relationship to SBN and User's System (4-Channel)**

The NOAAPORT broadcasts can be received at the C-band frequencies of 3994.050 MHZ (for the GOES EAST channel), 3991.700 MHZ (for the GOES WEST channel), 3990.150 MHZ (for the NCEP/NWSTG channel), and 3992.875 MHZ (for Non-GOES Imagery/DCP Channel). The GOES EAST, GOES WEST and NCEP/NWSTG channels have a data rate of 1.536 Mbps. The Non-GOES Imagery/DCP Channel has a data rate of 768Kbps. Receiving the signal requires an appropriate ground station, consisting of an antenna and low-noise-block down converter (LNB), an interfacility link (signal and power cable) to interface the outdoor LNB to the inside demodulators, and a data processing unit with appropriate software to receive the SBN protocol data streams, strip off the protocol framing, and transfer the received data files to the user's system.

## **1.4 References**

AWIPS Development Phase Proposal, Schedule A, Satellite Broadcast Network. GTE Proposal to PRC. 24 July 1995

American National Standard for Advanced Data Communication Control Procedures (ADCCP) ANSI X3.66-1979

AWIPS/NWSTG Interface Control Document, Document Number AAO130006

AWIPS/NESDIS Interface Control Document, Document Number AAO130008

AWIPS-NOAAPORT Receive System/External System Interface Control Document, Document Number AAO130012

OFCM Standard Telecommunication Procedures for Weather Data Exchange, Document Number FCM-S3-1991

Preliminary Telecommunications Services Plan, 12 July 1989

Revised Telecommunications Service Plan for AWIPS Satellite Communications Network, Deliverable Number GIS-AWIPS-01, 21 February 1991

System/Segment Specification (Type-A) for the National Weather Service Advanced Weather Interactive Processing System (AWIPS), U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Document Number SSS-001-1994, CH8 1 August 1996

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## **2.0 NOAAPORT Broadcast System**

### **2.1 Signal Characteristics**

#### **2.1.1 Radio Frequency Characteristics**

Table 2.1.1-1, NBS Link Budget Parameters and Characteristics, lists the technical characteristics of the NBS signal. Exhibit 2.1.1-1, GTE Spacenet IV Transponder 13 Coverage, shows approximate signal strength values throughout the United States.

#### **2.1.2 Modulation/Demodulation Technique**

Modulation for all channels uses differential quadrature phase-shift keying (QPSK) and V.35 scrambling. Demodulation for all channels uses the spectral inversion and V.35 descrambling functions of the EFDData SDR54A, as follows:

- **Spectral Inversion:** This function, when active, compensates for reversal of the in-phase (I) and quadrature (Q) channels of a QPSK– modulated signal between the uplink modulator and the downlink demodulator.
- **V.35 Descrambling:** This function assures transitions are received by the demod regardless of the data content. It operates as follows: The demod must regenerate the data stream and data clock using the Bit Timing Loop. It maintains the data clock position at the center of the data levels by looking for transitions in the data and keeping these transitions centered between the clocks. For this to work and to continue working over time with real data, which may have numerous data values that are identical before a transition, the scrambling is added to introduce extra transitions. These extra transitions must be added in such a way that the demod can remove them. This is accomplished as shown in Exhibit 2.1.2-1, Scrambler/Descrambler Block Diagram, by using the same pseudo-random sequence generator (recirculating shift register) for scrambling and descrambling, except that the input to the shift register is controlled by a 2:1 data selector and the SCRAM/DESCRAM control line. In the mod (scrambler), the input data are routed to the output exclusive-or (XOR) node, and the output is selected to go back to the shift register. In the demod (descrambler), the input data go to both the output XOR node and to the shift register input. For both scrambling and descrambling, the 3rd and 20th shift register stage outputs are XORed with the input to introduce extra transitions. Additionally, the 1st and 9th stage outputs are XORed and used to enable or reset a 5-bit (32-state) counter. If the 1st and 9th stage outputs are the same for 31 consecutive data clocks, the enabled counter reaches its terminal count and outputs a bit to output XOR to break the sequence. Whenever the 1st and 9th stage outputs differ, the counter is cleared and must restart its count.

**Table 2.1.1-1. NBS Link Budget Parameters and Characteristics**

<b>Characteristics</b>	<b>NCEP/NWSTG Data Stream</b>	<b>GOES EAST Data Stream</b>	<b>GOES WEST Data Stream</b>	<b>Non-GOES Imagery/DCP</b>
Data Rate	1536 Kbps	1536 Kbps	1536 Kbps	768 Kbps
Modulation Phases	4	4	4	4
Convolutional Coding Rate	3/4	3/4	3/4	3/4
Reed Solomon Coding Rate	(225,205)	(225,205)	(225,205)	(225,205)
Transponder	SN4 13	SN4 13	SN4 13	SN4 13
Transponder Input Backoff	5.9 dB	5.9 dB	5.9 dB	5.9 dB
Transponder Output Backoff	3.0 dB	3.0 dB	3.0 dB	3.0 dB
Attenuator Setting	3 dB	3 dB	3 dB	3 dB
Carrier to Interference Ratio	18.0 dB	18.0 dB	18.0 dB	18.0 dB
Transponder Usable Bandwidth	72 MHZ	72 MHZ	72 MHZ	72 MHZ
Faded System Margin	1.0 dB	1.0 dB	1.0 dB	1.0 dB
Transmit Site	Ft. Meade, MD	Ft. Meade, MD	Ft. Meade, MD	Ft. Meade, MD
Transponder Center Frequency	6205 MHZ	6205 MHZ	6205 MHZ	6205 MHZ
Transmit EIRP	63.6 dBW	63.6 dBW	63.6 dBW	60.6 dBW
Free Space Loss	199.8 dB	199.8 dB	199.8 dB	199.8 dB
Uplink Margin	0.5 dB	0.5 dB	0.5 dB	0.5 dB
Saturated Satellite Flux Density	-80.5 dBW/m <sup>2</sup>	-80.5 dBW/m <sup>2</sup>	-80.5 dBW/m <sup>2</sup>	-80.5 dBW/m <sup>2</sup>
Effective Satellite Flux Density	-77.5 dBW/m <sup>2</sup>	-77.5 dBW/m <sup>2</sup>	-77.5 dBW/m <sup>2</sup>	-77.5 dBW/m <sup>2</sup>
Satellite Ground Terminal	22.7 dB/°K	22.7 dB/°K	22.7 dB/°K	22.7 dB/°K
Required $E_b/N_o$ for $1 \times 10^{-6}$ BER	4.8	4.8	4.8	4.8
Channel Frequency (Uplink)	6215.050 MHZ	6219.050 MHZ	6216.700 MHZ	6217.875 MHZ
Channel Frequency (Downlink)	3990.150 MHZ	3994.050 MHZ	3991.700 MHZ	3992.875 MHZ
Channel Polarization	Vertical	Vertical	Vertical	Vertical

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**Exhibit 2.1.1-1. GTE Spacenet IV Transponder 13 Coverage**

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**Exhibit 2.1.2-1. Scrambler/Descrambler Block Diagram**

### 2.1.3 Error Control Coding

The uplink modulators and demodulators implement a concatenated code that incorporates a convolutional encoder/decoder, a data interleaver/de-interleaver, and a Reed Solomon encoder/decoder. The specific demodulators that will be used in the receive sites are the EFDData SDR54A with the Reed Solomon concatenated code. A block diagram of the decoder is shown below:

**Data Stream Decoder  
High-Level Block Diagram**



The pertinent characteristics of the data stream are as follows:

Non-GOES Imagery/DCP Data Rate	768 Kbps
NCEP/NWSTG Data Rate	1536 Kbps
GOES EAST Data Rate	1536 Kbps
GOES WEST Data Rate	1536 Kbps
Differential Encoding	ON
Modulation	QPSK
Scrambler	ON
Convolutional Code Constraint Length	$k = 7$
Convolutional Code Rate	$3/4$
Interleave Depth	16
Reed Solomon Code (N, K, t)	(225, 205, 10) per IESS -308, Appendix G
Reed Solomon Symbol Size	8 bits

### 2.2 Data Stream

The initial implementation of the NBS consists of three data streams: GOES EAST, GOES WEST, and NCEP/NWSTG. An additional data stream is planned: Non-GOES Imagery/DCP data. The following paragraphs describe the data streams being broadcast as of 1 September 1997.

## 2.2.1 GOES EAST

The GOES EAST data stream comprises the following images extracted from the GOES EAST satellite image set: Eastern CONUS, supernational composite, NH composite, Puerto Rico national, and Puerto Rico regional. The Eastern CONUS data stream includes a 1 km VIS channel, three 4 km IR channels (IR channels 2, 4, and 5), and an 8 km WV channel (IR channel 3). The supernational data stream contains an 8 km VIS channel, three 8 km IR channels, and an 8 km WV channel. The NH data stream contains a 24 km VIS channel, three 24 km IR channels, and a 24 km WV channel. The Puerto Rico national data stream contains 6 km VIS channel, a 6 km IR channel, and a 6 km WV channel. The Puerto Rico regional data stream contains a 1 km VIS channel, three 4 km IR channels, and an 8 km WV channel. Table 2.2.1-1, GOES EAST Data, depicts the GOES EAST products that are in the data stream.

**Table 2.2.1-1. GOES EAST Data**

Product	KBytes per Product	Images per Hour Normal Mode	Images per Hour Warning Mode
Eastern CONUS			
Visible	26222	4	8
Infrared	4920	(4 groups of 3) 12	(8 groups of 3) 24
Water Vapor	410	4	8
Super National Composite			
Visible	1526	2	2
Infrared	4578	(2 groups of 3) 6	2
Water Vapor	1526	2	2
Northern Hemisphere Composite			
Visible	526	2	2
Infrared	1578	(2 groups of 3) 6	2
Water Vapor	526	2	2
Puerto Rico National			
Visible	906	2	2
Infrared	906	2	2
Water Vapor	906	2	2
Puerto Rico Regional			
Visible	3688	4	4
Infrared	694	(4 groups of 3) 12	(4 groups of 3) 12
Water Vapor	58	4	4

To budget the GOES EAST data stream for future growth and to keep the data rate in even digital signal, level zero, (DS0) increments, the maximum data rate has been set at 1,536 Kbps.

## 2.2.2 GOES WEST

The GOES WEST data stream comprises the following images extracted from the GOES WEST satellite image set: Western CONUS, supernational composite, NH composite, Alaska national, Alaska regional, Hawaii national, and Hawaii regional. The Western CONUS data stream includes a 1 km VIS channel, three 4 km IR channels (IR channels 2, 4, and 5), and an 8 km WV channel (IR channel 3). The supernational data stream contains an 8 km VIS channel, three 8 km IR channels, and an 8 km WV channel. The NH data stream contains a 24 km VIS channel, three 24 km IR channels, and a 24 km WV channel. The Alaska national data stream contains an 8 km VIS channel, an 8 km IR channel, and an 8 km WV channel. The Alaska regional data stream contains a 2 km VIS channel, three 8 km IR channels, and a 16 km WV channel. The Hawaii national data stream contains a 14 km VIS channel, a 14 km IR channel, and a 14 km WV channel. The Hawaii regional data stream contains a 1 km VIS channel, three 4 km IR channels, and an 8 km WV channel. Table 2.2.2-1, GOES WEST Data, depicts the GOES WEST products that are in the data stream.

**Table 2.2.2-1. GOES WEST Data**

Product	KBytes per Product	Images per Hour Normal Mode	Images per Hour Warning Mode
Western CONUS			
Visible	21304	4	8
Infrared	3999	(4 groups of 3) 12	(8 groups of 3) 24
Water Vapor	333	4	8
Super National Composite			
Visible	1526	2	2
Infrared	4578	(2 groups of 3) 6	6
Water Vapor	1526	2	2
Northern Hemisphere Composite			
Visible	526	2	2
Infrared	1578	(2 groups of 3) 6	6
Water Vapor	526	2	2
Alaska National			
Visible	906	2	2
Infrared	906	2	2
Water Vapor	906	2	2
Alaska Regional			
Visible	3718	4	4
Infrared	700	(4 groups of 3) 12	12
Water Vapor	58	4	4
Hawaii National			
Visible	765	2	2
Infrared	765	2	2
Water Vapor	765	2	2
Hawaii Regional			
Visible	4661	4	4
Infrared	876	(4 groups of 3) 12	12
Water Vapor	73	4	4

To budget the GOES WEST data stream for future growth and to keep the data rate in even digital signal, level zero, (DS0) increments, the maximum data rate has been set at 1,536 Kbps.

### 2.2.3 NCEP/NWSTG

The NCEP/NWSTG data stream comprises free text, Binary Universal Form for Data Representation (BUFR), Gridded Binary (GRIB), and Graphics (Redbook) data. The free text data are in American Standard Code for Information Interchange (ASCII) and include products such as field-generated and NWSTG text and observation data. The BUFR data include products such as NWSTG upper air collective and profiler data. The GRIB data include products such as the nested grid model (NGM), National Meteorological Center (NOAA) (NMC) aviation model (AVN), medium-range forecast (MRF) model, Early Eta (80 km), MesoEta (40 and 20 km), and rapid update cycle (RUC) (80 km) data. The Graphics data include products such as manually generated nonmodel data. Vendor proprietary products also are broadcast on the NCEP/NWSTG data stream.

To budget the NCEP/NWSTG data stream for future growth and to keep the data rate in even DS0 increments, the broadcast data rate has been set at 1,536 Kbps.

### 2.2.4 Non-GOES Imagery/DCP Data

This data stream, planned for implementation in 1998, will likely include GOES Data Collection Platform (DCP) data and selected satellite imagery from the European METEOSAT and Japanese GMS satellites.

## 2.3 Data Format

The NBS uses the concept of encapsulation and the International Standards Organization (ISO) Open Systems Interconnection (OSI) reference model to define its data transmission format. The OSI reference model uses a seven-layer model to abstract the necessary functionality for communications between computer systems. The seven-layer model as shown in Table 2.3-1 contains the Physical Layer, Data-Link Layer, Network Layer, Transport Layer, Session Layer, Presentation Layer, and Application Layer.

Table 2.3-1. OSI Reference Model

	Layer	Functional Description
1	Physical	Transmits raw bits over a communications channel. Deals with the mechanical, electrical, and procedural interfaces as well as the physical medium
2	Data Link	Provides point-to-point communications over the physical medium by creating and recognizing frame boundaries
3	Network	Controls the operations of a subnet by determining how packets are routed from source to destination)
4	Transport	Manages fragmentation and reassembly of data to be passed into a network and ensures that all the pieces arrive at the intended destination (the beginning of the end-to-end communications layers
5	Session	Allows users of different machines to establish "sessions" between them
6	Presentation	Provides mechanisms to perform the encoding and decoding of data in a standard way
7	Application	Provides mechanisms for commonly needed functions such as file transfers and terminal emulation

The OSI reference model does not dictate the use of all layers for every application. Rather, it encourages application developers to use the appropriate functionality for their specific application. The NBS uses only four layers, as depicted in Exhibit 2.3-1, NBS Protocol Stack.

Exhibit 2.3-1 illustrates the NBS architecture using the classic OSI layers. This architecture uses a simplex broadcast scheme in which the communications between layers is in one direction only, broadcast to receiver. As a result, there is no flow control. The NBS uses high-level data-link control (HDLC) framing for the Data-Link Layer and the PRC-developed SBN protocol for the Transport Layer. The Presentation Layer incorporates the World Meteorological Association (WMO)/NESDIS headers for NESDIS products and the Communications Control Block (CCB)/WMO headers for NWSTG products. The protocols for the Data-Link Layer, Transport Layer, and Presentation Layer are further defined in Appendix A.

As the individual products are packaged for transmission, they are enveloped by the headers of the Presentation, Transportation, and Link protocol layers used by the NBS. As shown in Exhibit 2.3.2, the products are first wrapped in their corresponding Presentation Layer headers according to product type. The NESDIS products use the WMO and NESDIS headers, and the NWSTG products use the CCB/WMO headers. The first frame of a NESDIS product contains only header information, while the succeeding frames contain only the image data. Each frame of information contains one or more scan lines of image data, which are approximately 5,120 bytes. Summing the header data and the image data results in a NESDIS frame that can contain up to 5,152 bytes. The first frame of an NWSTG product contains the CCB/WMO header and product data. Succeeding frames contain only the product data, with each NWSTG frame containing up to 4,000 bytes of product data.

The next layer is the Transport Layer, which places the SBN protocol headers around the product/image data and Presentation Layer headers. The first frame of each distinct product of this layer contains the frame-level header (FH), a product-definition header (PDH), an AWIPS product-specific header (PSH), and the appropriate source data. Subsequent frames of the same product contain only the FH, the PDH, and the appropriate source data. The FH, PDH, and AWIPS PSH are defined in Appendix A.

The Transport Layer also contains several layers of sequence numbers. The first level sequences the frames, allowing the protocol to recognize lost frames. The next level sequences the products, which allows the protocol to recognize lost or damaged products. The final level of sequencing is used in reassembling the product. The sequence numbers do not provide flow control; their purpose is strictly error control.

The final layer before the data are converted to a radio frequency signal and uplinked to the satellite is the Data-Link Layer. In this layer, the data created by the Transport and Presentation Layers are enveloped by an HDLC frame and stamped for error control with a frame check sequence Cyclical Redundancy Check (CRC)-16.





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## **Appendix A**

### **Custom Protocols and Error Control Codes**

## Appendix A

### Custom Protocols and Error Control Codes

#### 1.0 Data-Link Layer Protocol

The NOAAPORT Broadcast System (NBS) uses a subset of the high-level data-link control (HDLC) protocol for its Data-Link Layer. The Data-Link Layer, as defined by the International Standards Organization (ISO) Open Systems Interconnection (OSI) reference model, provides point-to-point communications over a physical transmission medium by creating and recognizing frame boundaries. The NBS uses the HDLC frame and HDLC framing boundaries for this purpose.

The HDLC framing code or flag sequence consists of a 0 bit followed by six 1 bits followed by a 0 bit (01111110). It is used to demarcate the boundaries of a message packet. The rest of the message packet uses the general format shown in Exhibit 1.0-1. This consists of a beginning frame flag sequence (F), an address field (A), a control field (C), an optional information field (I), the frame check sequence (FCS), and an ending frame flag sequence (F).

<b>01111110</b>	<b>Address</b>	<b>Control</b>	<b>Information</b>	<b>FCS</b>	<b>01111110</b>
-----------------	----------------	----------------	--------------------	------------	-----------------

**Exhibit 1.0-1. HDLC Frame Structure**

Because the NBS is a point-to-multipoint system, the address field is set to the broadcast address: 11111111. The control field is always present in the frame but is not used by the Satellite Broadcast Network (SBN) protocol. As a result, the SBN protocol does not look at its value but assumes that it is present in the frame. The optional information field houses the SBN protocol and its associated data. The FCS field is used by the HDLC protocol to verify the integrity of each HDLC frame. In general, the NBS uses the HDLC frame to envelop the SBN message packets. Table 1.0-1 provides more details of the HDLC framing.

**Table 1.0-1. Details of HDLC Framing**

<b>Field</b>	<b>Description</b>	<b>Size (octets)</b>	<b>Value</b>	<b>Meaning of Value</b>
<b>A</b>	<b>Link-level address of the destination</b>	<b>1</b>	<b>11111111</b>	<b>Broadcast message.</b>
<b>C</b>	<b>Command/response control codes</b>	<b>1</b>	<b>N/A*</b>	<b>HDLC control is not used.</b>
<b>I</b>	<b>Data (optional)</b>	<b>32 - 5,200</b>	<b>N/A</b>	<b>This field contains the data packet that is further defined in the SBN protocol.</b>
<b>FCS</b>	<b>Error detection code</b>	<b>2</b>	<b>N/A</b>	<b>This field contains the calculated CRC-16.</b>

\* Not Applicable

The 0 bit insertion/deletion required by HDLC enables the flag sequence to frame bit streams into a packet, thus allowing the data between framing flags to contain any bit pattern. This is known as transparency. At the transmitting station, a 0 bit is inserted after each sequence of five consecutive 1s. At the receiving station, the 0 bit that follows every five consecutive 1 bits is deleted.

The NBS encodes the data using nonreturn-to-zero (NRZ) encoding. This encodes a 1 as a high level and a 0 as a low level. With this encoding method, only a minimal amount of clocking information is available in the data stream in the form of transitions on bit-cell boundaries, which do not allow for self-clocking.

The Cyclical Redundancy Check (CRC)-16 FCS uses the International Telegraph and Telephone Consultative Committee (CCITT) Rec. V.41 generating polynomial  $X^{16}+X^{12}+X^5+1$ .

The HDLC maximum frame size of 5200 bytes was chosen to allow an entire GOES image scan line to be contained within a single HDLC frame. The remainder of the HDLC protocol is unused.

## 2.0 Transport Layer Protocol

The SBN protocol was created for the NBS to provide for packet fragmentation and reassembly, to multiplex multiple product types into a single packet (for future consideration) and to multiplex multiple logical channels onto one data stream. The SBN header is divided into three functional areas: a 16-byte frame-level header that provides fixed locations for the HDLC header and locations for logical channel control; 16-byte product-definition header that uniquely defines the product(s) being transferred and permits the multiplexing of multiple products into the packet; and an optional 32-byte product-specific header that defines the specific product being transmitted. Exhibit 2.0-1 depicts the generalized SBN header structure.

Frame-Level Header (FH)	Product-Definition Header (PDH)	Product-Specific Header (PSH)
-------------------------	---------------------------------	-------------------------------

**Exhibit 2.0-1. Generalized SBN Header**

In application, the product-specific header is followed by the data as depicted in Exhibit 2.0-2. Each time a new product is started, the product-definition header indicates the start of a product, and the product-specific header details the AWIPS-specific information about the product. The succeeding packets then contain the data instead of the product-specific header. When all the data for a particular product are delivered, the product-definition header will indicate the end of the product.

Retransmission of previously broadcast products is supported by the NBS. Products are retransmitted in their entirety. If a product is a retransmission of a previous product, all of the required additional information is provided in the AWIPS product-specific header. A flag bit of 0x10 in the product-specific header flag indicates the product is a retransmission of a previous product. The original product sequence number and the original run ID are provided by the

Frame 1:

Frame-Level Header
Product-Definition Header (START)
Product-Specific Header
Data

.....  
.....  
.....

Frame i + 1:

Frame-Level Header
Product-Definition Header (IN PROCESS)
Data

.....  
.....  
.....

Frame N:

Frame-Level Header
Product-Definition Header (END)
Data

Exhibit 2.0-2. Typical Data Transfer

original product sequence number field and the original run ID field, respectively. Note that each retransmitted product has a new product sequence number like all products (in addition to the original product sequence number and run ID). This original product information allows a receive system to optionally discard duplicate products if the original product was received without error.

Tables 2.0-1 through 2.0-3 provide details on these header sections. The product-specific header (defined in Table 2.0-3) is AWIPS specific and conveys information about the product so that processing of that product is more efficient.

**Table 2.0-1. Frame-Level Header**

Field	Size (octets)	Description
HDLC address	1	The HDLC address field. This field is always all 1s (broadcast).
HDLC control	1	The HDLC control field. This field is not used.
SBN version	1	The most significant 4 bits, indicate the SBN version. The least significant 4 bits indicate the header length in 32-bit words, including the HDLC address/control fields.
SBN control	1	This is a reserved field used by the transmitter to indicate the logical channel of the message packet. This field is not currently being used.
SBN command	1	This is the message-packet command field. The following command values and associated functions are currently implemented: 3 = Product format data transfer 5 = Synchronize timing 10 = Test message
SBN data stream	1	Identifies the channel (data stream): 1 = GOES EAST 2 = GOES WEST 3 = Reserved 4 = NOAAPORT OPT (Non-GOES Imagery/DCP) 5 = NMC (NCEP/NWSTG) 6 = Reserved 7 = Reserved
SBN source	1	Source of data transmission: 1 = Generated at primary NCF 2 = Reserved
SBN destination	1	Destination of data transmission: 0 = All
SBN sequence number	4	Unique sequence number for each frame. This field is used in detecting lost packets. Currently ARQ or selective repeat is not implemented.
SBN run	2	Unique run identifier. This field will be incremented each time the sequence number is reset.
SBN checksum	2	Checksum is used for frame validation. Unsigned sum of all bytes in frame level header (except this field of 2 bytes).

**Table 2.0-2. Product-Definition Header**

<b>Field</b>	<b>Size (octets)</b>	<b>Description</b>
<b>Product-Definition Header Version Number</b>	<b>1</b>	The most significant 4 bits identify the product definition version. The least significant 4 bits indicate the header length in 32-bit words.
<b>Transfer Type</b>	<b>1</b>	Indicates the status of a product transfer: 1 = Start of a new product 2 = Product transfer still in progress 4 = End (last packet) of this product 8 = Product error 32 = Product Abort 64 = Option headers follow; e. g., product-specific header
<b>Header Length</b>	<b>2</b>	Total length of product header in bytes for this frame, including options.
<b>Block Number</b>	<b>2</b>	Used during fragmentation and reassembly to identify the sequence of the fragmented blocks. Blocks are number 0 to n.
<b>Data Block Offset</b>	<b>2</b>	Offset in bytes where the data for this block can be found relative to beginning of data block area.
<b>Data Block Size</b>	<b>2</b>	Number of data bytes in the data block.
<b>Records per Block</b>	<b>1</b>	Number of records within the data block. This permits multiple records per block.
<b>Blocks per Record</b>	<b>1</b>	Number of blocks a record spans. Records can span multiple blocks.
<b>Product Sequence Number</b>	<b>4</b>	Unique product sequence number for this product within the logical data stream. Used for product reassembly integrity to verify that blocks belong to the same product.

Table 2.0-3. Product-Specific Header

Field	Size (octets)	Description
Option Field Number	1	These three fields precede the first block of a product.
Option Field Type	1	
Option Field Length	2	
Product-Specific Header Version	1	AWIPS product-specific header version number.
Product-Specific Header Flag	1	Indicates the status of a product transfer: 1 = Start of a new product 2 = Product transfer still in progress 4 = End (last packet) of this product 16 = Product Retransmit
Product-Specific Data Length	2	Length of AWIPS product-specific header (in bytes).
Number of Bytes per Record	2	For GOES images, this is the number of bytes per scan line.
Product-Specific Type	1	Identifies the type of product Type: 1 = GOES EAST 2 = GOES WEST 3 = NOAAPORT OPT (Non-GOES Imagery) 4 = NWSTG (NCEP/NWSTG) 5 = NEXRAD
Product-Specific Category	1	Identifies the category of the product, i.e., image, graphic, text, grid, point, binary, other.
Product Code	2	Identifies the code of the product. (Numeric value of 0 to 255)
Fragments	2	Total number of blocks or fragments this product was broken into. 0 = multiple products in this frame # = number of fragments -1 = unknown
Next Header Offset	2	Offset in bytes from the beginning of this product-specific header to the next product -specific header. Reserved for future consideration.
Reserved	1	Reserved for future use
Product Source	1	Product original source at central interface (e. g., NWSTG PVC, etc).
Original Product Sequence Number	4	Original product sequence number as sent by NCF. Used during retransmit only; otherwise, the value is 0.
Product NCF Receive Time	4	Time that product started being received at NCF
Product NCF Transmit Time	4	Time that product started transmit from NCF
Current product-specific Run ID	2	Unique product-specific run identifier (parm for retransmission)
Original Product Run ID	2	Original run ID for product (used during retransmit only)

### 3.0 Presentation Layer Protocol

The Presentation Layer protocols are standard protocols employed by the National Oceanic and Atmospheric Administration (NOAA) and the National Weather Service (NWS). They include the World Meteorological Organization (WMO) header and National Environmental Satellite Data and Information Service (NESDIS) header used by the NESDIS products and the Communication Control Block (CCB) and WMO headers used by the NWS Telecommunications Gateway (NWSTG) products. The following paragraphs briefly describe the formats of the various product headers; however, for further details about the protocols one must examine the references given.

#### 3.1 NESDIS Products

The Presentation-Level headers for the NESDIS products, as depicted in Exhibit 2.3-2, contain the WMO header followed by the NESDIS header. These headers are briefly described in the following paragraphs.

##### 3.1.1 WMO Header

The WMO header used by the NBS uses an abbreviated heading for product identification. This heading has the following format:

$T_1T_2A_1A_2ii$  (sp) CCCC (sp) YYGGgg [(sp)BBB] (cr)(cr)(lf)

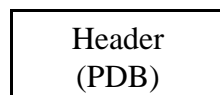
in which

$T_1T_2A_1A_2ii$	=	Data designators
(sp)	=	Space
CCCC	=	International four-letter location indicator of the station originating or compiling the bulletin
YYGGgg	=	International date-time group
BBB	=	An abbreviated heading defined by $T_1T_2A_1A_2ii$ CCCC YYGGgg that will not be used for NESDIS products
(cr)	=	Carriage return
(lf)	=	Line feed

and is identified in the AWIPS/NWSTG Interface Control Document (Document Number A0130006).

##### 3.1.2 NESDIS Header

The NESDIS format envelops the visible (VIS), infrared (IR), and water vapor (WV) products and contains the following format:



The header is the Product Definition Block (PDB), which defines the product records. Each record contains one scan line of image data and the end of the image is identified by the end

of the block terminator. The details of the protocol and its formats are defined in AWIPS/NESDIS Interface Control Document (Document Number AAO130008).

### 3.2. NWSTG Products

The Presentation-level headers for the NESDIS products, as depicted in Exhibit 2.3-2, contain the CCB header followed by the WMO header. These headers are briefly described in the following paragraphs.

#### 3.2.1 CCB Header

The CCB defines the data formats and/or code forms so that the recipient of the message can determine the proper host processing required to decode the message. The details of the protocol and its formats are defined in reference OFCM Standard Telecommunication Procedures for Weather Data Exchange FCM-S3-1991.

#### 3.2.2 WMO Header

The WMO header used by the NBS uses an abbreviated heading for product identification. This heading has the following format:

$T_1T_2A_1A_2ii$  (sp) CCCC (sp) YYGGgg [(sp)BBB] (cr)(cr)(lf)

in which

$T_1T_2A_1A_2ii$	=	Data designators
(sp)	=	Space
CCCC	=	International four-letter location indicator of the station originating or compiling the bulletin
YYGGgg	=	International date-time group
BBB	=	This optional group indicates amendments (AMD), corrections (COR), routine delay (RTD), or parts (PAA)
(cr)	=	Carriage return
(lf)	=	Line feed

and is identified in the AWIPS/NWSTG Interface Control Document (Document Number A0130006).

**Appendix B**  
**Data Format of NWS ONLY**  
**and Proprietary Products**

## **Appendix B**

### **Data Format of NWS ONLY and Proprietary Products**

The only proprietary product currently broadcast over the NCEP/NWSTG data stream is real-time lightning data. The use of this encoded data requires a site license from the lightning product contractor (Global Atmospheric, Inc., 2705 East Medina Road, Tucson, AZ 85706).

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## **Appendix C**

### **List of Acronyms and Abbreviations**

## **Appendix C**

### **List of Acronyms and Abbreviations**

ARQ	Automatic Repeat Request
ASCII	American Standard Code for Information Interchange
AWIPS	Advanced Weather Interactive Processing System
AVN	NCEP's aviation model
BER	bit error rate
BUFR	Binary Universal Form for Data Representation
CCB	communication control block
CCITT	International Telegraph and Telephone Consultative Committee
CONUS	conterminous United States
CRC	cyclical redundancy check
dB	decibel
dB/°K	decibels per degree Kelvin
dBW	decibels relative to one watt
dBW/M <sup>2</sup>	dBW per square meter
DS0	digital signal, level zero
EIRP	effective isotropic radiated power
ERL	Environmental Research Laboratories (NOAA)
FCS	frame check sequence
FH	frame-level header
FSL	Forecast Systems Laboratory
GHz	gigahertz
GMT	Greenwich mean time
GOES	Geostationary Operational Environmental Satellite
GRIB	gridded binary
HDLC	High-level Data-link Control
HQ	Headquarters
IR	infrared
ISO	International Standards Organization
Kbps	kilobits per second
km	kilometer
LNB	low-noise block
Mbps	megabits per second
MGS	Master Ground Station
MHZ	megahertz

NBS ..... NOAAPORT Broadcast System  
 NC ..... National Center  
 NCEP ..... National Centers for Environmental Prediction  
 NCF ..... Network Control Facility  
 NESDIS ..... National Environmental Satellite, Data, and Information Service  
 NH ..... northern hemisphere  
 NMC ..... National Meteorological Center (NOAA)  
 NOAA ..... National Oceanic and Atmospheric Administration  
 NRZ ..... nonreturn to zero  
 NWS ..... National Weather Service (NOAA)  
 NWSTG ..... National Weather Service Telecommunications Gateway  
  
 OSI ..... Open System Interconnection  
  
 PDH ..... product-definition header  
 PRC ..... PRC Inc.  
 PSH ..... product-specific header  
  
 QPSK ..... Quadrature Phase-Shift Keying  
  
 RF ..... radio frequency  
 RFC ..... River Forecast Center  
 RUC ..... rapid update cycle  
  
 SBN ..... Satellite Broadcast Network  
 SN4 ..... Spacenet IV  
  
 VIS ..... visible  
  
 WFO ..... Weather Forecast Office  
 WMO ..... World Meteorological Organization (UN)  
 WV ..... water vapor  
 XOR ..... exclusive-or